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Rita S. McAllister

Naval Aerospace Medical Research Laboratory
Pensacola, Florida

30 June 1973

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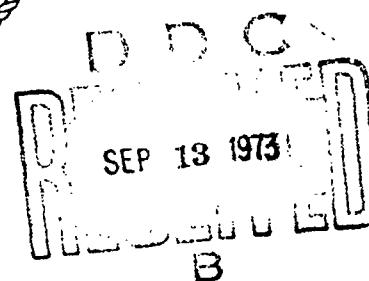
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30 June 1973

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FOREWORD

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RITA S. McALLISTER

TABLE OF CONTENTS

Bureau of Medicine and Surgery
Navy Department

<u>Work Unit</u>	<u>Title of Task</u>	<u>Page</u>
MR041.01.01-0120B8FG	Mechanisms Underlying the Behavior of the Organs of Equilibrium Which Result in Motion Sickness, Functional Reflex Disturbances, and Other Unwanted Side Effects in Navy Personnel	1
MR041.01.01-0133D1DX	Hyperbaric-Hypobaric Interactions as They Relate to Compressed Air Diving and Aviation.	1-2
MF51.524.002-5012DX5X	Predicting Motivational Change and Aero-nautical Adaptability Among Navy and Marine Corps Aviation Trainees	2-4
MF51.524.002-5013DX5X	Predicting Fleet Effectiveness of Navy and Marine Corps Pilots and Flight Officers	4-6
MF51.524.004-2006DX5L	Analysis of Operational Functions and Unique Characteristics of the Naval Flight Officer	6-7
MF51.524.005-5016BX1J	Investigation of Pilot Background Factors in Aviation Accidents	7-8
MF51.524.015-0014BX7X	Performance in Non-human Primates as Influenced by Low Frequency Electromagnetic Fields	8-9
M4305.08.3007DXD0	Cockpit Assignability Codes and Techniques for the Presentation of Anthropometric Data	9-10
NASA Sponsored Reports		10-11
Special Reports		12-13
Monographs		14-17
Reports listed previously and subsequently printed in journals		18
Open literature publications by staff members		19-22
Author index		23

Work Unit

MR041.01.01-0120B8FG
NAMRL-1005
(AD 748 192)

Effects of Some Antimotion Sickness 5/31/72
Drugs and Secobarbital on Postural
Equilibrium Functions at Sea Level
and at 12,000 Feet (Simulated)

A. R. Fregly, M. J. Smith, C. D. Wood,
and D. B. Cramer

Abstract:

This study was undertaken to determine the effects of six antimotion sickness drugs, three placebos, and secobarbital on postural equilibrium functions at sea level and at 12,000 feet (Chamber simulated). These effects, as defined by performance on a quantitative ataxia test battery, were investigated on nine normal men.

Analysis of variance revealed that, relative to the other drugs and placebos, only secobarbital had a deleterious effect on the performance skills studied--both at sea level and at 12,000 feet--whereas none of the antimotion sickness drugs alone or in combination differed significantly from placebos in having such an effect in either environment. This finding was highly consistent and in keeping with the known depressant effects of secobarbital on CNS activity.

Among the antimotion sickness drugs, only the combination of d-amphetamine (10 mg) plus scopolamine (0.6 mg) at altitude had a significant enhancing effect on performance relative to the reverse (depressing) effect found at sea level.

MR041.01.01-0133D1DX
NAMRL-1176

The Measurement of Pulmonary 1/3/73
Extravascular Water Volume During
Exposure to Simulated High Altitude

Raphael F. Smith and Lloyd H. Ramsey

Abstract:

To investigate basic mechanisms operative in high altitude pulmonary edema, pulmonary extravascular water volume (Qpevw) was measured in 11 unanesthetized calves exposed

Work Unit

to atmospheres equivalent to 12,000 and 16,000 feet. Measurements were made by a double indicator dilution technique at sea level and after continuous exposure of 24, 48, and 72 hours. Thirty-five duplicate measurements from 15 experiments yielded a test-retest reliability coefficient of 0.84. Data from 15 experiments were technically satisfactory after exposure of 24 hours; 13 experiments after 48 hours exposure; and 7 experiments after 72 hours exposure. After 24 hours exposure the mean increase in Q_{pevw} was 42.7 ml ($p < .025$); after 48 hours 79.3 ml ($p < .005$); and after 72 hours, 29.3 ml (N.S.). There was no significant difference in Q_{pevw} for the same duration of exposure at 12,000 feet and 16,000 feet. It is concluded that Q_{pevw} increases in the bovine lung after exposure to high altitude.

M51.524.002-5012DX5X.4
NAMRL-1171
(AD 754-757)

The Effects of Instructor Differences 11/10/72
Upon Student Progress in Naval Aviation Training

W. L. Waag and R. H. Shannon

Abstract:

The present investigation attempted to determine: (1) whether instructor differences could be measured quantitatively; (2) if such differences affected the grades which they assigned; and (3) if such differences affected the student's progress through the flight training program. Using an unstructured rating form, it was found that reliable instructor differences could be identified in terms of how they characteristically evaluate students. Furthermore, such differences were found to affect the grades which they assigned, although the magnitude of such effects was quite small. Moreover, these differences were not found to affect the student's progress through the program in terms of his pipeline assignment, subsequent flight grades, or his chances of receiving his wings. These data support the contention that flight instructor standardization procedures from an operational point of view have been successful.

Work Unit

MF51.524.002.5012DX5X.8
NAMRL-1181

A Factor Analytic Study of Attritions From Naval Aviation Training

6/4/73

W. L. Waag, R. H. Shannon, R. K. Ambler and A. G. Baisden

Abstract:

Students who do not successfully complete naval training are asked to complete an open-ended questionnaire concerning their reasons for entering and leaving the program, their likes and dislikes about the program, and characteristics of their instructors. The purpose of the present study was: 1) to develop an objectively structured questionnaire from an analysis of responses of a large sample of attritions to this open-ended questionnaire; 2) to identify the most salient factors emerging from responses to the newly developed questionnaire; and 3) to compare attritions from the pilot and NFO training program on these response factors.

An objectively structured questionnaire was developed, administered to a sample of 221 attritions, and the data analyzed by a series of principal components factor analyses. For each of six major content areas, a small number of well-defined and easily-interpretable factors emerged. Loadings from the pilot-NFO dichotomy revealed differences on a substantial number of factors.

Based on the findings of this study, it is recommended that the newly-developed questionnaire be revised and implemented on a continuing basis.

MF51.524.002.5012DX5X.7
NAMRL-1175
(AD 757 693)

The Use of Confidential Instructor Ratings for the Prediction of Success in Naval Undergraduate Pilot Training

2/7/73

W. L. Waag, R. H. Shannon and R. K. Ambler

Work Unit

Abstract:

Previous investigations have reported significant relationships between confidential instructor ratings in early primary phase and later success in Naval flight training. Such ratings were found to increase significantly the validities derived solely from selection test scores. However, such findings do not guarantee that confidential ratings would augment the validities derived from the combined array of selection and early training variables which are used in the current Student Pilot Prediction System. The purpose of the present study was to determine whether such confidential ratings provided non-redundant information which would increase the predictive value of the present system.

The results clearly indicate that confidential ratings obtained from Primary flight instructors provided information relating to the student's probability of receiving his wings. Such ratings were found to significantly increase the predictive validities derived from the variables which are used currently in the Student Pilot Prediction System. Such findings suggest that these confidential evaluations provide additional information beyond that which is reflected in the grades he assigns.

It is recommended that confidential instructor ratings be implemented on a permanent basis in the presolo stage. The present Student Pilot Prediction System should be revised to incorporate this information.

MF51.524.002-5013DX5X.4
NAMRL-1158
(AD 748 195)

A New Approach to Criterion Development in the Replacement Air Group 7/10/72

R. H. Shannon, W. L. Waag and J. C. Ferguson

Abstract:

The present investigation attempted to isolate the most critical skills and procedures within each of the stages comprising replacement air group (RAG) training in the F-4 aircraft. For

Work Unit

each of the stages analyzed, a small set of graded items were selected on the basis that they could adequately discriminate among replacement pilots categorized as "above average," "average," or "below average," according to their final overall RAG grade. Such items were found to be highly predictive of the stage grade from which they were obtained. A multiple R of .839 was obtained, predicting the final RAG grade when only five of the selected maneuvers were entered into the equation. These findings indicate the feasibility of isolating a small set of skills and procedures which will be highly predictive of pilot performance in the RAG. It is suggested that such "critical" items should form the basis from which an adequate measure of fleet performance might be developed.

MF51.524.002.5013DX5X.5
NAMRL-1173
AD 755 184

Toward the Development of a Criterion for Fleet Effectiveness in the F-4 Fighter Community

12/5/72

R. H. Shannon and W. L. Waag

Abstract:

A recurring problem in naval aviation has been the lack of adequate criteria for pilot performance in fleet-type aircraft. In a previous investigation, an attempt was made to isolate the most critical skills and procedures within each of the stages comprising East Coast replacement air group (RAG) training in the F-4 aircraft. The present investigation attempted to replicate these findings from the East Coast RAG with data obtained from the West Coast RAG squadron.

For each of the stages analyzed in the East Coast RAG squadron, a small set of graded items was selected on the basis that they could adequately discriminate among replacement pilots according to their final RAG grade. The resulting set of items was found to be highly predictive of both the stage grade from which they were obtained and the final RAG grade. Data were obtained from the West Coast RAG squadron

Work Unit

in an attempt to replicate these findings. For the items common to both squadrons, a multiple of R of .852 was obtained for the East Coast sample using the final RAG grade as the criterion. Using the beta weights obtained from the East Coast sample, predictions were derived for pilots in the West Coast sample. The resulting correlation between predicted and observed RAG grades was .776.

MF51.524.002-5013DX5X.6
NAMRL-1174
(AD 910 044L)

Human Factors Engineering Deficiencies Aboard CVAs 11/18/72

T. J. Gallagher and J. E. Goodson

Abstract:

Three tragic conflagrations occurred aboard CVAs during the recent past. The cost was 207 lives, \$130.6 million, and 14.5 months off line. Each incident was associated with systems' deficiencies in human factors engineering. These and many more deficiencies could be alleviated for a small fraction of that cost by application of human engineering principles.

A survey of documented human factors engineering discrepancies aboard eight CVAs is reported. There is no indication that these are being corrected, either in newer classes or in overhaul and repair.

One system aboard the CVA, the CONFLAG, is discussed in detail concerning its human factors engineering deficiencies. Redesign in accordance with human factors engineering principles at four levels of sophistication is discussed.

MF51.524.004-2006DX5L.1
NAMRL-1170
(AD 754 059)

A Function Level Commonality Analysis of the F-4/F-14 NFO Positions 11/8/72

J. B. Shelnutt and R. H. Shannon

Abstract:

The introduction of the F-14, the Navy's newest fighter, into the fleet creates an additional demand on the fighter Naval Flight Officer (NFO)

Work Unit

training pipeline. In an attempt to define this demand, this study compares the F-14 with the F-4 in terms of the operational functions required of the NFO in each aircraft. Using NFO advisors, and F-14 and F-4 publications, a Function Description Inventory (FDI) was created. The FDI consists of the various tasks, duties, and roles comprising the operational functions of the NFO on either or both aircraft. NFOs familiar with both aircraft rated the tasks on three dimensions: Proportion of Time and Effort (P), Importance (I), and Complexity (C). These ratings were then used as a basis for discussion of the differences in NFO operational functions between the two aircraft.

A majority of the tasks were rated the same for both the F-4 and F-14 on the P and I dimensions. Important exceptions to this trend are found in the roles of Sensor Manager and Tactician. Eighteen per cent of the total tasks were rated as unique to the F-14, with a majority of these tasks being found in the roles of Sensor Manager and Weapons Manager. In terms of the C dimension, 26 per cent of the tasks were rated as increasing in difficulty in the F-14, 44 per cent were rated similar and 13 per cent were rated as decreasing.

MF51.524.005-5016BX1J.11
NAMRL-1163
(AD 749 695)

Orientation-Error Accidents in 8/28/72
Regular Army UH-1 Aircraft During
Fiscal Year 1969: Relative Incidence
and Cost

W. C. Hixson, J. I. Niven and E. Spezia

Abstract:

This report is the third in a longitudinal series of reports dealing with the magnitude of the pilot disorientation/vertigo accident problem in Regular Army UH-1 helicopter operations. Incidence and cost data presented for fiscal year 1969 include a total of 46 major and minor orientation-error accidents (16 of which were fatal), resulting in 39 fatalities, 67 nonfatal injuries, and \$8,130,297 aircraft damage.

Work Unit

MF 51 .524 .005 .5016BX1J .12
NAMRL-1169
(AD 753 208)

Major Orientation-Error Accidents 10/20/72
in Regular Army UH-1 Aircraft During
Fiscal Year 1969: Accident
Factors

W. C. Hixson, J. I. Niven and E. Spezia

Abstract:

This report is the third in a longitudinal series of reports dealing with the pilot disorientation/vertigo problem in Regular Army UH-1 Helicopter operations. Individual case history data extracted from the USABAAR master aircraft accident files are presented on 44 major orientation-error accidents that occurred in UH-1 aircraft during fiscal year 1969. Summary data listings involving a variety of operational and pilot-related accident factors are presented for each of the cases. The listings are arranged to distinguish between those factors and events present before takeoff; i.e., the initial conditions associated with a given accident, and those which occurred or were manifested during the actual airborne phase of the accident flight.

MF 51 .524 .015-0014BX7X .1
NAMRL-1155
(AD 754 058)

Operant Behavior of Rhesus Monkeys 11/1/72
in the Presence of Extremely Low
Frequency-Low Intensity Magnetic
and Electric Fields: Experiment 1

John de Lorge

Abstract:

The present study was one of the several designed to measure specific operant behaviors and discover effects of exposure of animals to extremely low frequency magnetic and electric fields of low intensity in support of the U. S. Navy's attempt to scientifically explore the biological effects of these fields. Measurements of immediate memory, operant responding, and reaction time were obtained on two rhesus monkeys. No significant changes could be related to the exposure of these animals to a magnetic field of 10 gauss at 75 Hz or to the electric field of 4 v/m at 75 Hz. The results provide supportive evidence that these specific

Work Unit

M4305.08.3007DXD0.1
NAMRL-1164
(AD 752 032)

electromagnetic fields have no general
behavioral influence on non-human primates.

Empirical Reduction in Potential 9/21/72
User Population as the Result of
Imposed Multivariate Anthropometric
Limits

W. F. Moroney, and M. J. Smith

Abstract:

Workspaces, from desk top consoles to aircraft cockpits, have traditionally been designed to accommodate the "average man" (50th percentile on all anthropometric features) or individuals included within some specific range about the median (5th through 95th percentiles; 1st through 99th percentiles, etc.). Manufacturers usually design equipment such that clearances, reach distances, and other critical measurements will accommodate individuals having all their anthropometric features in the 5th to 95th percentile range. A more stringent requirement, currently in effect for aircraft cockpits, specifies accommodation of individuals with anthropometric features ranging from the 3rd to the 98th percentiles. The classic solution to these design requirements has been to construct mannequins or engineering sketches with the anthropometric features of a "3rd, 5th, 50th, 95th or 98th percentile man."

The establishment of these critical limits (3rd, 5th, 95th, and 98th percentiles) assumes implicitly that if only the "less than 5th" and "greater than 95th" percentile individuals are not accommodated then only 10 per cent of the available sample will be excluded. Given this same assumption, if the 3rd and 98th percentile limits are selected, only 5 per cent of the available sample should be eliminated. Such a procedure presupposes that those individuals with an anthropometric measurement beyond the established range on one anthropometric characteristic will be the same individuals who fall outside the established range on all other anthropometric features.

Work Unit

This supposition is demonstrably false to the extent that multiple anthropometric features are involved in the design of workspaces.

Data describing thirteen, cockpit related, anthropometric features of 1547 naval aviator personnel were examined. Two analyses were performed on these data. In the first analysis individuals not included within the 5th percentile to the 95th percentile critical limits on any of the 13 features cited above were eliminated. After all 13 eliminations had been completed, 874 (52.6%) of the original 1547 had been excluded. In the second analysis, the critical limits were established at the 3rd and 98th percentiles, and 499 (32.2%) of the personnel were excluded. Thus, where one might have expected only 10 per cent of the population to have been excluded, 52.6 per cent were excluded, and where only 5 per cent theoretically might have been excluded, 32.2 per cent were excluded. This seeming discrepancy may be attributed to the intercorrelations existing between the 13 variables. The importance of considering the relationship between anthropometric features in determining amthropometric compatibility is discussed. The preparation of bivariate data, which is not variable specific but which could be used when the correlation between anthropometric feature is known, is proposed.

NASA W-13433
NAMRL-1162
(AD 748 713)

Direction-Specific Adaptation Effects 7/11/72
Acquired in a Slow Rotation Room

Ashton Graybiel and James Knepton

Abstract:

Thirty-eight subjects were required to execute 120 head movements in a slow rotation room at each 1-rpm increase in velocity of the room between 0 and 6 rpm and, after a single-step gradual return to zero velocity, execute 120 head movements either immediately after the return or after delay periods varying from 1 to 24 hours unless, at any time, more than mild

Work Unit

symptoms of motion sickness were elicited. A second stress profile differed by the sequential addition of an incremental adaptation schedule (identical to the first) in which the direction of rotation was reversed. The experimental findings demonstrated the acquisition of direction-specific adaptation effects that underwent spontaneous decay with a short time constant (hours). With their disappearance a nondirection-specific adaptation was revealed with a long time constant (days). Speculations are presented which could account for the simultaneous acquisition of short-term and long-term adaptation effects. The findings support the theory that motion sickness, although a consequence of vestibular stimulation, has its immediate origin in nonvestibular systems, implying a " facultative" or temporary linkage between the vestibular and nonvestibular systems.

NASA W-13280
NAMRL-1172
(AD 754 427)

Dosimetric Characteristics of HZE
Particles in Space 11/15/72

Hermann J. Schaefer

Abstract:

HZE particles; i.e., galactic heavy primaries with very high values of Linear Energy Transfer (LET) pose a special radiation hazard on manned space missions. While cellular destruction by single hits has been demonstrated, more general data on dose/effect relationships are not available since conventional concepts and units of radiation dosimetry are not applicable. The report summarizes existing knowledge on the energy spectrum of galactic heavy primaries and analyzes the microdosimetric pattern of energy dissipation in tissue. It is shown that the LET distribution shows a steep negative slope with the frequency of events decreasing steeply with increasing LET down to less than one event per cm^3 tissue per day at 4000 kev/micron tissue. Assessing the HZE particle hazard requires new approaches in both radiobiological experimentation and dosimetric instrumentation.

Work Unit

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Special Reports

NAMI 72-2

A Limited Review of the Effect of
Cigarette Smoking on Performance
with Emphasis on Aviation

11/22/72

R. S. Gibson and W. F. Moroney

Abstract:

Increased knowledge concerning the detrimental effects of smoking has created a desire to identify any adverse effects that smoking might have on aircrew performance. A limited review of the literature was undertaken to provide some perspective on the likely effects of smoking on variables related to aircrew performance. The authors concluded that cigarettes do significantly affect various sensory thresholds, but that the significance of these effects appear to be of little practical importance. They also noted that withdrawal does produce significant performance decrements.

NAMRL 73-1
(AD 759 342)

Classification, Analysis, and Inter- 3/13/73
pretation of Animal Neoplasms in
Northwest Florida and NAMRL

R. J. Brown, J. L. Kupper and
W. P. Trevethan

Abstract:

Disease surveillance in animals closely associated with man provides important zoonotic sentinel information. Often animals are accurate models of response to environmental factors that also affect man. This is especially true and of even greater significance in recent years with the ever increasing list of viral and chemical carcinogens.

Tabulation and study of animal tumors provide excellent training and review in general comparative pathology for those pathologists working almost exclusively in primate pathology. Even more importantly, however, a broad spectrum of animal pathology is required to meet the residency requirements of the American College of Veterinary Pathologists. The usual laboratory comparative pathology cases (rats, mice,

Special Reports

nonhuman primates, rabbits, etc.) at the Naval Aerospace Medical Research Laboratory, plus the usual canine and feline material from Northwest Florida permit military veterinarians assigned to the Naval Aerospace Medical Laboratory to count this time toward board certification in pathology. This NAMRL Special Report is a summary of the neoplastic cases observed at this institute from July 1968 until February 1973.

One-hundred and fifty neoplastic cases from Northwest Florida were reviewed. Ninety-one (60.7%) were benign and 59 (39.3%) were malignant. Dogs accounted for the majority of the tabulations. The skin was the most common site of both malignant and benign neoplasms. The occurrence of lymphosarcoma in the dog was higher than reported as average in the United States.

Monographs

No. 17
(AD 747 987)

The Influence of Selected Factors 9/7/71
on Shrinkage and Overfit in
Multiple Correlation

Norman E. Lane

Abstract:

Weighting of variables in a regression equation so as to maximize prediction of a criterion presents several problems. Optimal weighting in the sample case means that chance-related error is also weighted indiscriminately. Because such error will not relate to the criterion in subsequent samples, a sample multiple correlation (R) will be on the average larger than the population value (overfit), and its value on cross-validation will be lower than in the equation-development sample (shrinkage). The influence of characteristics of the population and other conditions of the sampling situation on the outcome and stability of the regression equation has not been well understood. In particular, the role played by the relationship of initial predictor set size (M) to sample size (N) has not received adequate attention.

This study attempted to examine and isolate the role of sampling error in the magnitude and stability of sample multiple R values obtained by incremental test selection techniques. The effect of selected factors on the impact of sampling error was examined. Three proposed shrinkage estimation formulas were evaluated for effectiveness, and a search was conducted for more efficient formulas incorporating the M/N ratio. Methods of controlling shrinkage and overfit were discussed and evaluated. Throughout the study efforts were made to determine empirical guidelines for the reduction of error in the equation-development process.

The basic design was a 3^4 factorial, with four major design variables governing the generation of data-Number of Predictors (M), Sample Size (N), Homogeneity (average intercorrelation of predictors) (H), and Population R value (P).

Monographs

Each design variable had three levels. A factor structure with one common factor for criterion and predictors was developed and used to generate data from a random number sub-routine. Each of the 81 combinations of design variables was replicated 20 times. Multiple correlation techniques were applied to generated variables, and equations were cross-validated. Analysis of variance was performed on resulting overfit, shrinkage and other values, an importance of each design variable in determining their values was assessed. Three shrinkage formulas were compared, and a search for alternative formulas carried out.

Results showed the striking importance of the M/N ratio in determining equation instability and consequent shrinkage, and indicated the necessity for shrinkage formulas to take such terms into account. It was found that it is not the number of variables selected which is primarily influential in shrinkage, but rather the size of the predictor set from which variables are selected. When M/N is high, opportunities for error from other factors such as weight reversals are great; a low ratio increases stability and reduces effects of such factors. Problems of stringency/leniency for stopping selection of variables were discussed; it was shown that it may be advantageous to use different shrinkage estimation formulas for termination and for estimating true shrinkage. Tentative formulas for both purposes were proposed, and necessity for further evaluation discussed. Analogies between test selection and simultaneous significance testing were drawn, and an F-ratio test was developed that holds constant the probability of false selection throughout equation development, reducing and estimating the likelihood of spurious predictors.

Guidelines were suggested to enable the user of predictor composites to control, eliminate, or interpret some of the problems noted. It was

Monographs

pointed out where problems may occur, and that alternatives exist to many practices traditionally used.

No. 19
(AD 751 569)

Field Dependency-Independency. A 6/21/72
Review of the Literature

Gerald M. Long

Abstract:

In recent years the Rod-and-Frame Test (RFT) and the Embedded-Figures Test (EFT), both theoretical indices of an individual's field dependency or independency, have been employed as effective tools in the investigation of very practical "real-world" phenomena and problems. Kennedy (1972), for example, found EFT scores to be significantly related to success in aviation training for both naval aviators and naval flight officers. With this increasing popularity of the concept in general and the apparent interest demonstrated by fellow psychologists, the present paper was undertaken as an extensive review of the field independence-field dependence concept. It is hoped that this monograph presents an objective picture of the "state of the art" of Witkin's perceptual dimension.

No. 20
(AD 749 352)

The Relationship Between Habituation 7/3/72
to Vestibular Stimulation and Vigilance: Individual Differences and
Subsidiary Problems

Robert S. Kennedy

Abstract:

It has been shown that a subject's mental state is an important variable when recording vestibular nystagmus. This experiment is in three parts. In the first part the relationship of one form of mental work (vigilance scored in percent correct) to vestibular nystagmus habituation and eye movement phase relationships recorded during prolonged cyclic oscillation was studied. In the second part individual differences (personality, hours sleep, etc.) were related to

Monographs

vigilance performance and nystagmus habituation. In the third part the interaction of subject variables with vigilance tasks of differing complexity is reported. In addition, methodological studies were appended to the main body of this monograph. These include: 1) a bibliography and experiments concerning effects of luminance on electro oculographic potentials; 2) normative data for a vigilance task; 3) correlations between personality (extraversion, field independence) and success in aviation training, and 4) reliability and validity of a scoring method for nystagmus habituation.

No. 21
(AD 747 988)

Human Head and Neck Response to Impact Acceleration 8/10/72

C. L. Ewing and D. J. Thomas

Abstract:

A methodical investigation and measurement of human dynamic response to impact acceleration was conducted as a Joint Army-Navy-Wayne State University investigation.

Linear accelerations were measured on the top of the head, at the mouth, and at the base of the neck. Angular velocity was also measured at the base of the neck and at the mouth. A redundant photographic system was used for validation. All data were collected in computer-compatible format and data processing was by digital computer. Selected data analysis on 41 representative human runs involving 12 subjects of the 236 human runs completed to date are presented.

Description of the experimental design, data collection and processing is given in detail. Ancillary research efforts in support of the program are also described.

Representative plots of the human kinematic response are presented, discussed, and compared. Repeatability and quality control plots are also presented. There are a total of 755 computer drawn plots illustrating a characteristic, repeatable response of human subjects to impact acceleration.

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AUTHOR INDEX

Ambler, R. K. - 3

Baisden, A. G. - 3

Baker, R. O. - 19

Bird, J. - 19

Britz, W. E. - 19

Brown, R. J. - 12, 19

Bucky, S. F. - 18, 19

Collins, W. E. - 21

Cramer, D. B. - 1, 18, 20

Davis, R. D. - 19

de Lorge, J. - 8

Ewing, C. L. - 17, 20

Ferguson, J. C. - 4, 21

Flowers, L. - 19

Fountain, J. E. - 19

Fregly, A. R. - 1, 18

Furry, D. E. - 21

Gallagher, T. J. - 6

Gibson, R. S. - 12

Gilson, R. D. - 18, 20, 21

Goodson, J. E. - 6

Graybiel, A. - 10, 18, 20, 22

Guedry, F. E., Jr. - 18, 20, 21

Hecker, M. H. L. - 21

Hewitt, J. E. - 20

Hixson, W. C. - 7, 8, 20

Hoche, J. P. - 21

Horne, A. F. - 19

Johnson, N. L. - 19

Kennedy, R. S. - 16

Knepton, J. - 10, 18

Kupper, J. L. - 12, 19

Lane, N. E. - 14

Levin, B. W. - 21

Long, G. M. - 16, 20

McClure, J. A. - 18

Miller, E. F. II - 20

Miller, R. F. - 20

Molina, E. A. - 18

Moroney, W. F. - 9, 12

Mosko, J. D. - 21

Niven, J. I. - 7, 8, 20

Oosterveldt, W. J. - 20

Ramsey, L. H. - 1

Ridley, S. L. - 18

Robertson, R. M. - 21

Schaefer, H. J. - 11, 20, 21

Schraeder, D. J. - 21

Shannon, R. H. - 2, 3, 4, 5, 6, 18, 21

Shelnutt, J. B. - 6

Smith, J. P. - 21

Smith, M. J. - 1, 9, 18

Smith, R. F. - 1

Spezia, E. - 7, 8

Stevens, K. M. - 21

Stockwell, C. G. - 18, 21

Stoop, D. R. - 21

Sullivan, J. J. - 20

Trevethan, W. P. - 12, 19

Thomas, D. J. - 17

Waag, W. L. - 2, 3, 4, 5, 18, 21

Williams, C. E. - 21, 22

Wood, C. D. - 1, 18, 22